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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/627,238	07/24/2003	Claus-Rupert Hohenthanner	13430 US	4183

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EXAMINER	
LEWIS, BEN	

ART UNIT	PAPER NUMBER
1795	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/627,238	HOHENTHANNER ET AL.	
	Examiner	Art Unit	
	Ben Lewis	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-6,8 and 11-21* is/are pending in the application.

4a) Of the above claim(s) *11-19* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6,8,20 and 21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *24 June 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *10/19/07*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on October 19th, 2007 has been entered. Claims 1 and 20-21 have been amended. Claims 11-19 were withdrawn. Claims 7 and 9-10 were cancelled.

Claim Rejections - 35 USC § 112

The claim rejections under 35 U.S.C. 112, second paragraph, on claims 20-21 are withdrawn, because the claims have been amended.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-6, 8 and 20-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Starz et al. (U.S. Patent No. 6,500,217) in view of Yano (U.S. Patent No. 5,380,806) and Tsai et al. (U.S. 6,514,296 B1).

With respect to claims 1, 5 and 20-21, Starz et al disclose a process for applying electrode layers to a polymer electrolyte membrane strip for fuel cells wherein the above and other objects of the invention can be achieved by a process for applying electrode layers on to a polymer electrolyte membrane strip "substrate" in a desired pattern, wherein the front and back of the membrane are continuously printed with the electrode layers in the desired pattern using an ink containing an electrocatalyst and the printed electrode layers are dried at elevated temperature immediately after the printing operation, the printing taking place while maintaining accurate positioning of the patterns of the electrode layers on the front and back in relation to one another (Col 2 lines 54-64).

Starz et al also teach that to produce membrane-electrode assemblies, an ink with the following composition was used:

Ink: Catalyst 20% Pt 15.3 g on Vulcan XC72 NAFION Polymer 5.1 g

Tetrabutylammonium hydroxide 2.0g Li_2CO_3 5.5g Glycerol 127.7g Alcohol, water 44.6g

(Examiner notes that since the ink composition of Starz et al. contains water as a constituent then the ink composition of Starz et al. is water based).

Regarding drying the catalyst-coated substrate at an elevated temperature, Starz et al teach that during the actual printing operation the polymer membrane is held, printed and then moved on by the repeat distance of the coating pattern. This operation is repeated until the entire polymer membrane is coated. The printed electrodes are dried by means of the continuous drier 12 a drying temperature of between 60 and 150 ^{0}C being selected. Hot-air or infrared driers which gently remove the solvents from the coating are preferably used. The drying time needed is regulated by the speed of the polymer strip (Col 6 lines 25-40).

With respect to leveling, Starz et al. teach that the printing process takes place with an ink which contains an electrocatalyst. This ink is often also referred to as a paste because of its consistency. In addition to a high boiling-point solvent it contains, for example, one or more electrocatalysts, proton-conducting ionomer and optionally auxiliaries such as wetting agents "leveling agent", pore forming agents or similar (Col 3 lines 19-33). Starz et al. does not specifically teach leveling the deposited catalyst ink. However, Yano disclose an ink composition (title) wherein when the amount of the leveling agent is less than about 0.1 part by weight, a rough surface of the coating film attributed to the remainder of the foam generated at the time of the printing and the screen mesh is not sufficiently leveled, and pinholes are likely to be formed on the surface after drying and curing, so that the film tends to have a nonuniform thickness (Col 6 lines 25-45). Therefore it would have been obvious to incorporate the leveling procedure of Yano into the process of Starz et al. because Yano teach that if the mesh

is not sufficiently leveled, pinholes are likely to be formed on the surface after drying and curing, so that the film tends to have a nonuniform thickness (Col 6 lines 25-45).

Starz et al. as modified by Yano does not specifically teach controlling the temperature and humidity. However, Tsai et al. disclose a method of making an energy storage device (title) wherein the coating solution is applied to the support by a spray method, cured, and optionally repeated to increase the thickness. A preferred procedure is to apply the coating solution to the substrate at a temperature of 0-150 °C by means of an ultrasonic or other spray nozzle with a flow rate of around 0.1-5 ml/min in a carrier gas composed of nitrogen, oxygen and/or other reactive and inert gases. The coating characteristics are controlled by the partial pressure of oxygen and other reactive gasses (Col 13 lines 40-50). Usually, constant temperature and humidity are important to obtain an even coat (Col 19 lines 40-50). Therefore it would have been obvious to one of ordinary skill in the art to incorporate the controlling of the temperature and humidity of Tsai et al. into the leveling process of Starz et al. as modified by Yano because Tsai et al. teach that usually, constant temperature and humidity are important to obtain an even coat (Col 19 lines 40-50).

With respect to the coating step occurring in a coating compartment and the leveling step occurring in a leveling compartment, the coating and leveling steps of Starz et al. as modified by Yano takes place in the same compartment which anticipates the limitation of to the coating step occurring in a coating compartment and the leveling step occurring in a leveling compartment as evidenced by the Examiner's interpretation of claim 21 wherein the Applicant claims that "the coating step (a) and the leveling step

(b) are performed in one large compartment comprising a coating section and a leveling section."

With respect to the length of time of the leveling step, the disclosure Starz et al. as modified by Yano and Tsai et al. differs from Applicant's claims in that Starz et al. as modified by Yano and Tsai et al. do not disclose leveling times as claimed by Applicant. However, Yano recognize the need for adjusting the residence time of the polymer membrane in the drying station. Yano teach that if the mesh is not sufficiently leveled, pinholes are likely to be formed on the surface after drying and curing, so that the film tends to have a nonuniform thickness (Col 6 lines 25-45). Therefore, it would have been within the skill of the ordinary artisan to adjust the leveling time of the polymer membrane of Starz et al. as modified by Yano and Tsai et al. to within the Applicants claimed leveling time range in order to guarantee uniform thickness. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art.* In re Boesch, CCPA 1980, 617 F.2d 272, 205 USPQ215.

With respect to claims 2 and 3, Starz et al teach that to produce membrane-electrode assemblies, an ink with the following composition was used:
Ink: Catalyst 20% Pt 15.3 g on Vulcan XC72 NAFION Polymer 5.1 g Tetrabutylammonium hydroxide 2.0g Li_2CO_3 5.5g Glycerol "surfactant" 127.7g Alcohol, water 44.6g (Col 7 lines 30-45).

With respect to claim 6, Starz et al teach a process for applying electrode layers to a polymer electrolyte membrane strip for fuel cells wherein the above and other objects of the invention can be achieved by a process for applying electrode layers on to a polymer electrolyte membrane strip " ionomer substrate" in a desired pattern, wherein the front and back of the membrane are continuously printed with the electrode layers in the desired pattern using an ink containing an electrocatalyst and the printed electrode layers are dried at elevated temperature immediately after the printing operation, the printing taking place while maintaining accurate positioning of the patterns of the electrode layers on the front and back in relation to one another (Col 2 lines 54-64).

With respect to claim 6, Starz et al teach that controlling the water contents of the membrane during the printing process enables the shrinkage and expansion properties of the membrane to be controlled and thus increases the accuracy of print positioning on front and back. The maximum water absorption capacity of a polymer electrolyte membrane based on perfluorinated sulfonic acid is a water content of about 30 wt. %. For the process according to the invention, water contents of 2 to 20, especially 10 to 20 wt. %, have proved suitable. Higher water contents lead to excessive expansion of the membrane associated with crack formation and reduced adhesion of the electrode layers. Alternatively, there is the possibility of adjusting the water content of the

membrane by treating it in a humid atmosphere with 50 to 100% relative humidity and at 40 to 90 ^{0}C (Col 4 lines 30-67).

With respect to claim 8, the disclosure Starz et al differs from Applicant's claims in that Starz et al. do not disclose leveling or drying times as claimed by Applicant. However, Starz et al. recognize the need adjusting the residence time of the polymer membrane in the drying station. Starz et al teach that the preferred temperatures for drying the layers are between 60 and 150^{0}C. The residence time of the polymer membrane in the drying station must guarantee adequate drying of the electrode layers. It depends on the temperature selected and can be prolonged by appropriate deflections in the drying station (Col 3 lines 5-19). Therefore, it would have been within the skill of the ordinary artisan to adjust the drying time of the polymer membrane of Starz to within the Applicants claimed drying time in order to guarantee adequate drying. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art.* In re Boesch, CCPA 1980, 617 F.2d 272, 205 USPQ215.

Response to Arguments

3. Applicant's arguments filed on October 19th, 2007 have been fully considered but they are not persuasive.

Applicant's principal arguments are

(a) With respect to the cited references, the Starz, et al. reference does not print a water-based ink; instead it uses an ink containing predominantly glycerol, which is a very high boiling solvent (see column 7 of Starz, et al.). There is no teaching or suggestion in Starz, et al. to use a water-based ink as now required in amended claim 1.

(b) Furthermore, as acknowledged by the Examiner, the Starz, et al. reference does not teach the use of a separate leveling step, and certainly does not teach the leveling requirement now set forth in amended claim 1.

(c) The Yano reference discloses a screen priming ink for the covering of flexible primed circuit boards (see claim 1). The ink of Yano comprises a polyurethane and epoxy component (see title). This ink does not contain any water. To the contrary, the composition is very sensitive to humidity, thus it has to be prepared under a nitrogen atmosphere (see the section "Examples", column 8, lines 30-46). Accordingly, the ink of Yano teaches away from the water-based ink of the present invention.

(d) Additionally, contrary to the opinion of the Examiner, the Yano reference does not disclose a "leveling procedure". Yano merely states that the amount of leveling agent must be adjusted to a range of 0.1 to 10 parts per weight in the ink formulation. If the

amount of leveling agent is less than 0.1 parts per weight, the screen mesh is not sufficiently leveled and a rough surface of the coating occurs. This is due to the fact that not enough leveling agent is contained in the ink. This problem cannot be remedied or adjusted by any additional leveling process or procedure.

(e) In summary, Yano and Tsai do not teach a coating process of water-based inks - the subject matter to which the present invention is directed. Yano's inks are humidity sensitive, as they contain polyurethane compounds. Tsai's inks are temperature sensitive as they contain a one pot epoxy with a pot life of 30 minutes at room temperature. Furthermore, Yano does not disclose a leveling process under humid atmosphere.

(f) Yano, Tsai and Starz are all silent in regard to a leveling process under controlled atmosphere and temperature, and they certainly do not disclose, teach or suggest a leveling period of 1 - 10 minutes, as required by the pending claims.

In response to Applicant's arguments, please consider the following comments.

(a) Starz et al also teach that to produce membrane-electrode assemblies, an ink with the following composition was used:

Ink: Catalyst 20% Pt 15.3 g on Vulcan XC72 NAFION Polymer 5.1 g Tetrabutylammonium hydroxide 2.0g Li_2CO_3 5.5g Glycerol 127.7g Alcohol, water 44.6g

(Examiner notes that since the ink composition of Starz et al. contains water as a constituent then the ink composition of Starz et al. is water based).

(b) and (d) Starz et al. does not specifically teach leveling the deposited catalyst ink. However, Yano disclose an ink composition (title) wherein when the amount of the leveling agent is less than about 0.1 part by weight, a rough surface of the coating film attributed to the remainder of the foam generated at the time of the printing and the screen mesh is not sufficiently leveled, and pinholes are likely to be formed on the surface after drying and curing, so that the film tends to have a nonuniform thickness (Col 6 lines 25-45). Therefore it would have been obvious to incorporate the leveling procedure of Yano into the process of Starz et al. because Yano teach that if the mesh is not sufficiently leveled, pinholes are likely to be formed on the surface after drying and curing, so that the film tends to have a nonuniform thickness (Col 6 lines 25-45).

(c) and (e) The Yano reference was relied upon to show obviousness of incorporating they leveling process of Yano in to the process of Starz et al. Furthermore, the Yano

reference is merely silent to water based inks. The Yano reference does not state that water cannot or must not be used.

(f) With respect to the length of time of the leveling step, the disclosure Starz et al. as modified by Yano and Tsai et al. differs from Applicant's claims in that Starz et al. as modified by Yano and Tsai et al. do not disclose leveling times as claimed by Applicant. However, Yano recognize the need for adjusting the residence time of the polymer membrane in the drying station. Yano teach that if the mesh is not sufficiently leveled, pinholes are likely to be formed on the surface after drying and curing, so that the film tends to have a nonuniform thickness (Col 6 lines 25-45). Therefore, it would have been within the skill of the ordinary artisan to adjust the leveling time of the polymer membrane of Starz et al. as modified by Yano and Tsai et al. to within the Applicants claimed leveling time range in order to guarantee uniform thickness. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art.* In re Boesch, CCPA 1980, 617 F.2d 272, 205 USPQ215.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ben Lewis whose telephone number is 571-272-6481. The examiner can normally be reached on 8:30am - 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Ben Lewis

PATRICK JOSEPH RYAN
SUPERVISORY PATENT EXAMINER

Patent Examiner
Art Unit 1745